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LETTER ADDRESSED TO SAMUEL P. LYMAM ESQ., COMMISSIONER NEW YORK AND ERIE RAILROAD, 14TH DECEMBER, 1838, BY W. R. CASEY, CIVIL ENGINEER. REVISED FOR THIS JOURNAL, AUGUST, 1839.

The leading points of comparison in rival lines of Railway are, as far as Engineering is concerned: the relative costs, grades, curves and lengths. It is to the influence which the last of these considerations should have on final locations, that I propose devoting this paper. From its apparent simplicity this subject has not, in my opinion, always received the attention its importance merits.

The graduation of a railway, after a few years, requires but little outlay to keep it in repair. The superstructure, on the contrary, is always liable to derangement and wear, especially when perishable materials are used. Thus the shorter route may cost more for graduation than the longer, and yet be kept in order at a less annual expenditure, until the interest of the capital invested in the extra amount of graduation on the shorter route equals the annual sum required for the repairs and renewals of the extra length of the longer. Still the shorter line will be passed over in less time and—what will sometimes be of equal, sometimes of greater importance—the repairs of cars and engines will be less, being exactly in proportion to the lengths of the routes,—grades and curves being considered equal.

The annual expenses of a railway may be divided into three distinct parts. 1st. The interest or prime cost of graduation, superstructure, engines, cars, buildings, etc. 2d. The repairs of the graduation and the repairs and renewals of the superstructure. 3d. Repairs and renewals of engines, cars, buildings, etc.; salaries of agents, engine-men, etc.; cost of fuel, oil and all expenditures not included under the two first heads.

The prime cost of the road itself is independent of the amount of freight

which may pass over it, but the engines, cars and buildings must be in proportion to that freight. The repairs of the graduation will not in any degree be affected by an increase of business and the annual expenses of the superstructure in a comparatively trifling ratio; but the expenses under the third head, increase with the freight and distance, and in the same proportion—hence, they are estimated at so much per ton, per mile. As a general elucidation rather than numerical accuracy is attempted, the nearest round numbers will be used. The entire cost of a double track, cars, engines, buildings, etc., necessary for an extensive business, will be assumed at $30,000 per mile, and the repairs and renewals of wooden superstructure at $1000 per mile, of double track per annum. The expenses under the third head will be estimated at one cent per ton per mile, and 100,000 tons will be assumed as the entire freight passing over the road in one year.

It appears then, that each mile of distance requires an annual outlay of the interest on prime cost, $30,000 *a* 5 per cent=1500 dollars—secondly, repairs and renewals of superstructure 1000 dollars, and thirdly, 100,000 tons at one cent, 1000 dollars;—in all $3500 per mile perannum, the interest at 5 per cent of $70,000.

By this calculation the reduction of the distance by one mile, will justify an expenditure of $70,000, or upwards of $13 per lineal foot of road. Nothing can more clearly or forcibly illustrate the importance of making the final location with every care, for the expense of a locating party for a whole day will be paid if they succeed in diminishing the distance by a single foot—a degree of accuracy of course unattainable in practice, and an extreme case, merely adduced to show the propriety of devoting all reasonable time, labor and expense towards reducing the distance to its minimum.

It may appear to some, that this reasoning is based on the principle, that true economy requires everything to be well done at first, and it may be urged, that the scarcity of capital in this country precludes the idea of carrying out this principle to its full extent; it must, however, be distinctly understood, that the *location* only, is here spoken of—the wooden superstructure may be replaced by stone and iron, the bridge of timber by the arch of granite and the wooden sheds by substantial edifices, but a bad location, like an error in architecture, can never be remedied.

A case of frequent occurrence will show the application of these remarks. Suppose the choice to lie between two routes not differing materially in cost of construction, the shorter of which is inferior to the longer in grades and curves, or both;—then the longer should not be preferred without ascertaining that the grades and curvature of the shorter cannot be rendered equal to those of the longer line by the expenditure of the sum due to the difference in distance. Before adopting the longer route, the surveys ought to *demonstrate* that the length cannot be reduced by an expenditure at that rate per mile, on the distance saved by the shorter line.

It is all important to observe, that the sum assumed as equivalent to the saving of a mile in distance is to be expended on the *graduation* only.

The thorough and systematic examination of the ground absolutely necessary for a location on this principle, will be attended with some collateral advantages. Thus, when the line consists of a series of curves, a diminution in distance will generally be effected by lessening the total curvature and overcoming this diminished variation with a larger radius. In addition to these important though incidental advantages, complete surveys will often show, that a good location is as cheap or cheaper than an indifferent one which has been run out, and is to be adopted, not because it is *known* to be the best line between the termini, but because it presents no very objectionable features and is within certain limits of grade and curvature which are not inadmissable.

In fixing on $70,000 as equivalent to a mile in distance, the freight was taken at 100,000 tons per annum. Now it is clear, that if the freight exceed 100,000 tons, the expenses under the third head will increase in the same ratio, and if the freight amount to 300,000 tons per annum, we shall, for this alone, incur an annual expense of $3000, the interest of $60,000, and adding to this the $30,000 per mile, prime cost, the repairs and renewals of superstructure requiring the interest of $20,000, and we find one mile equivalent to $110,000—neglecting a slight increase in the repairs of roadway, in consequence of the additional traffic and interest on prime cost of the cars, engines, etc., required to transport the additional 200,000 tons—the latter no trifling consideration, but purposely omitted, to show those who may not have studied this subject, that $110,000 per mile, however great a sum it may appear, is a low estimate of the advantages gained by reducing by one mile the length of a road over which 300,000 tons pass annually. The saving of time is also very important. Before many years elapse, the competition among the numerous roads leading from the Atlantic to the West will render every mile of unnecessary distance a drawback of the most serious nature, for the western traveller, in addition to paying a higher fare and incurring greater fatigue, is also subjected to the loss of time, on which he, whether justly or not, almost invariably places a higher value, than on either economy or comfort.

There is yet another argument which ought to have some weight. It cannot be doubted, that the time is not very distant when the interests of the New York and Erie Railway, as well as of the country, will require a superstructure of the very best kind, at a cost of not less than $20,000 per mile of double track, and every mile now saved will of course at that time be a direct gain of $20,000.

From all these considerations we see the impolicy of increasing the distance for the sake of passing by some village or mills, unless the business thence is at least sufficient to indemnify the Railway for the one cent per ton per mile, on the *entire* quantity of freight which may be expected to

pass over that increased distance, and, even then, the loss of time is neglected. It would in many cases be cheaper to build a side track to the village or mills, and give them the use of it; and if the increase of distance exceed 2 or 3 miles, the requisite cars and engines may be furnished without charge and with very decided advantage to the general interests of the road.

The New York and Erie Railroad is, however, to furnish another avenue from the city of New York to the Western country, and although this road, like the Erie Canal, will depend principally for its income on the country through which it passes, it is scarcely possible that the western trade should form so small a fraction of the income of the New York and Erie Railroad as it has for the last 10 years, of the income of the Erie Canal. Still the western trade and travel, though a secondary consideration, are far too important to be overlooked, and every unnecessary foot of distance aid directly in diverting to Philadelphia the business which this road should secure to New York. Whether the trade and travel of any part of the line will justify any, and, if any, what increase of distance is not an engineering question, but I should earnestly recommend a very close scrutiny into any proposal to increase the distance for the sake of local business, for every such additional foot becomes a direct tax on all the freight coming from, or going to places in this or other States to the westward of this unnecessary extension. Hence the location of the Eastern division is that on which too much attention cannot well be bestowed, for a very large proportion of the trade and travel of this State as well as the entire traffic of the West must always pass over that part of the route.

Since the first surveys, the distance has, I believe, been reduced about 33 miles, equivalent, at the lowest calculation, to above two millions of dollars, and producing a saving of one dollar on every ton, from the Western States, estimating the *entire* cost of transportation at the low rate of 3 cents per ton, per mile—very little more than three-fourths of the mere *tolls* on the government works of Pennsylvania. The difference in cost of transportation arising from this diminution in distance may lead to a vast increase of freight from the West, which again renders practicable a further reduction in price, by which the extent of country tributary to the road, will be proportionally increased.

It is not easy to avoid the impression, that, on so long a route as that of the New York and Erie Railway, a few miles more or less, is no very great object. It is true that a mile bears only a very small proportion to the length of this road; still the absolute expenditure per mile, remains the same, be the length what it may: and as the business will be in some degree in proportion to the distance between the termini, the objections to any unnecessary extension may be said rather to increase with the length of the road. Thus, the addition of one mile or 1-450th of its length to this road, would be more objectionable than the addition of an equal distance

to most of the short roads in the Union, though constituting from 1-40th to 1-15th of their length.

I conclude with observing, that, in competing with its formidable rivals, the New York and Erie Railroad has, in my opinion, more to fear from its great length, than from all other causes united.

DR. LARDNER'S INSTRUMENTS FOR EXPERIMENTING UPON RAILWAYS AND THE MOTION OF RAILWAY CARRIAGES.

Instrument for Detecting Vertical Deflexion.—To test the formation and stability of the road, it was determined to observe the effects which the rails and their supports suffered by the action of the wheels in passsing over them. Mr. Wood contrived and constructed instruments for this purpose, consisting of a simple lever, the shorter arm of which was placed either under the lip of the rail itself, or under a staple attached to the rail, so that when the rail would sink, the arm of the lever would be depressed, and if the rail would rise, the arm of the lever would rise also, by the superior weight of the longer arm. Thus every motion of the rail upwards and downwards would produce a contrary motion in the opposite end of the lever, and as the arms of this lever were unequal in the proportion of about six to one, the actual vertical deflexion of the rail was exhibited on a proportionary magnified scale by the motion of the longer arm. In order to register these deflexions, which usually were produced with great rapidity and in considerable number by the wheels of a train successively passing over the rail to which the instrument was attached, Mr. Wood adopted the same method as was previously used in several other self registering machines, A narrow strip of paper of considerable length, being rolled upon a small cylinder, was gradually unrolled from it to another cylinder, and as it passed from the one to the other, it was drawn over a disc, against which a pencil was pressed, which was carried by the longer end of the above-mentioned lever. The motion of this pencil, upwards and downwards, produced by the deflexion of the rail, would, if the paper were quiescent, merely draw a vertical line upon it; but by the motion of the paper under the pencil, every separate motion of the pencil upwards and downwards, produced a waving line, the summit of each wave exhibiting the magnitude of each deflexion. Three of these instruments were constructed by Mr. Wood, with a view to expedite the taking of the observations, so that being applied to different parts of the rail, three sets of deflexions would at the same time be taken by one passage of a train.

Instruments for Measuring Lateral and Horizontal Deflexions.—It will be perceived that the effect of the last instrument was only to measure the deflexion of the rail downwards or upwards. After Dr. Lardner had been some time engaged in experimenting with these, he succeeded in constructing another set of instruments, capable of measuring similar effects in the lateral or horizontal direction. These instruments consisted of a compound lever by which any motion of the shorter arm was magnified fifty times, so that when the shorter arm was drawn back or drawn forward in the horizontal direction through the fiftieth part of an inch, the end of the longer arm was moved upwards or downwards, according to the direction of the motion of the shorter arm through the space of an inch. The shorter arm of this lever, bore by a hardened steel point upon a flat circular disc of steel constructed on the end of a short rod or cylinder, moving horizontally in guides. The other end of this cylinder

was presented to the side of the rail to which was attached a hardened steel point which bore upon the disc; so that the cylinder thus moving in guides was placed between the two steel points, one attached to the rail, and the other to the short arm of the lever of the indicating instrument. The longer or indicating arm was furnished with a pencil, which registered its indications on paper, in the same manner as in the instruments contrived by Mr. Wood for registering the vertical deflexions. The two sets of instruments combined rendered the means of observation of the effects of carriages upon the rails complete. It is evident that the rail could not suffer any effect which would not be felt, measured, and registered by one or both of these instruments. To the experiments made with these instruments, at least one-third of the whole period of this inquiry was devoted, and many hundred diagrams were taken, exhibiting the effects produced not only on the rails themselves, but on the chairs by which they are supported on the timbers, where timbers are used, and on the stone blocks on which other railways are supported.

Instrument for Testing the Laying of Rails, &c.—In addition to these tests of the effects produced upon the rails by the traffic over them, Dr. Lardner proposed to apply another which would show the state of perfection with which the rails were laid, or their state after the lapse of any length of time. It is evident that on a straight line of railway, the two rails on which the wheels of the same carriage rest, ought to be at the same level, so that the carriage may stand in a truly horizontal position. A newly constructed road ought to be laid with sufficient precision to effect this; but after being worked for any length of time, it cannot be expected to preserve it. One rail will subside more than the other, owing to the different degree of firmness of its supports, and of the ballasting beneath them; in fact the rails will lose the correctness of their relative level, and the carriage, when resting on them, will not be as truly vertical in its position as it would be on a well and newly made railway. An instrument was contrived and constructed, which, being rolled slowly along the rails, wrote upon paper, as it went, with considerable precision, the extent to which the rails of the same line departed from a common level. The operation of this instrument may be easily explained. An iron tube, of about an inch in diameter, is formed of a length equal to the gauge of the line, or the width of the rails; at each end of this are two shorter legs at right angles to it, open at their ends; thus when the intermediate tube is placed in the horizontal position, the two short legs may be brought to the vertical position; and if the horizontal tube be extended between the lines of rails, the vertical tubes will be immediately over the centre of each rail. Now let us suppose this instrument fixed to a vertical frame, and placed on wheels or rollers, which shall rest upon the rails; let mercury be introduced into it until the horizontal tube and about half of each of the vertical tubes are filled. If the rollers which support the instrument be now made to rest upon the rails, the short tubes being in an upright position, the two surfaces of the mercury in the short tubes must, by the laws of fluids, be at the same level. If the rails be not at the same level, then the mercury will stand higher in the tube which is over the lower rail, than in that which is over the higher one. If the instrument be reversed, the mercury will also reverse its position relatively to the instrument, and will still stand higher in the tube which is over the lower rail.

When the instrument is adjusted, which it may easily be by this process, so that when the rails are truly level, the height of the mercury in one of the tubes is accurately known, then every change which that column of mercury undergoes, while the instrument is rolled over the rails, will

indicate a corresponding departure in the rails from the common level, that departure being twice as great as the rise or fall of the mercury.

In order to make this instrument register its own indications, Dr. Lardner placed on the column of mercury in the tube a float, the rod of which resting above the tube, moved in guides, so as to rise and fall regularly on the surface of the mercury on which it rested, rose, and fell; to this rod was attached a pencil, under which paper being moved in the usual way, a curve was described, whose height above a datum line was always equal to half the departure of the rails from a common level.

Among the several instruments, the invention and construction of which have arisen out of this important inquiry, there is not one which has equal general utility with this self-registering level, and it is only to be regretted that its construction was completed at so late a period that it has not been applied so extensively to the different lines as might have been wished. Its use, however, will not be confined to this investigation. The advantages which it will offer as a test of the condition of a newly made line, or of the manner in which the contractor will preserve one in operation, is obvious. It will be a check, whose indications cannot be disputed, and they are indications which involve the best qualities of a well made line. It is evident that its usefulness in practice may be extended by adding to it two other instruments on the same principle, to be rolled each along the same rail. The object of these would be to register every change of level of each rail, independently of the other, in addition to the register preserved by the present instrument of the departure of the two rails from a common level.

Instruments for Measuring the Vibration of Carriages.—An iron tube is extended across the floor of the carriage from door to door, from which rise two perpendicular legs at each door to the height of about twelve inches. The horizontal part of this tube extending along the floor is filled with mercury, which likewise fills the legs to the height of some inches from the angle of the tube, being similar in all respects to the tube used in the instrument for recording the relative levels of the rails. The principal irregularity of motion to which railway carriages are liable, being a lateral swinging to the right and to the left between the rails, this motion immediately affects the horizontal column of mercury which fills the tube extending along the floor, and the inertia of this column causes the column in the vertical tubes to oscillate in proportion to the lateral vibration of the carriage. A float is placed on the mercury in one of the vertical tubes, which bears a pencil similar to that described in the self-registering level, which pencil inscribes on paper each particular oscillation of the mercury, and its exact extent.

This, however, is only one of several irregular motions to which the carriages are liable. Another of these is a rocking motion, arising partly from the former lateral vibration, and partly from the irregularity of the level of the rails, either side of the carriage alternately sinking and rising, either as the relative levels of the rails change, or as the conical tires of the wheels mount upon them and descend by the lateral vibration. This rocking motion would cause a body placed at either side of the carriage alternately to ascend and descend in the vertical direction through a corresponding space, and at similar intervals. This motion was measured in the apparatus in the following manner:—a syphon barometer, formed of an iron tube of nearly an inch in bore, was placed at the side of the carriage, near one of the doors. This barometer would be raised and lowered as the side of the carriage itself was elevated and depressed by the irregularity of the motion; and this alternate vertical motion being imparted to

the mercury in the barometer, the latter, in virtue of its inertia, would receive a corresponding oscillation upon the same principle as the horizontal column in the tube was affected by the lateral motion. A float was placed in the shorter leg of the barometric syphon, which was made to inscribe the vibrations on paper in the same manner as the other instruments.

Besides this rocking motion, railway carriages, like others, are liable to more or less alternate vertical shake common to the whole body of the carriage; and although it was manifest that this was the smallest in amount of all the irregularities of motion, it was deemed right to ascertain it. This was accomplished by a small self-registering syphon barometer, placed in the centre of the carriage. All these three instruments were probably mounted upon the same frame, and their three pencils were made to act upon as many discs over which the paper was moved. The rolls of paper were all moved by the same winch, which acted upon a worm and a system of wheels driven by a common band, so that all the papers moved on the respective discs at the same rate, and received upon them the inscriptions corresponding to the different motions. In front of each disc was provided a stamp, bearing upon it the letter indicating the kind of motion recorded on the paper. Thus to the disc on which the horizontal motion was written, the stamp H was printed; to that on which the vertical motion was inscribed, the stamp V was printed; and that on which the rocking motion was recorded, was inscribed the stamp R. All these punches were attached to a common rod, and moved together by the lever provided for that purpose. A person stationed at the window of the carriage at the moment of passing each quarter of a mile, struck the lever with his hand, and punched a letter on the paper which moved over each disc. These letters divided the paper into spaces corresponding to each quarter of a mile, and vertical lines were subsequently drawn from it, which resolved the diagrams thus formed into portions corresponding to each particular quarter of a mile of the road traversed.

In this manner the number of jolts of the carriage, and the nature and amount of each jolt which took place in each quarter of a mile, were registered.

So satisfactory have been the indications of this instrument, that by inspecting the diagrams the general state of the road can be with great certainty pronounced. In passing along a newly made line, for example, it is at once rendered manifest when the train passes from a cutting to an embankment, the latter being in a state of settlement, and therefore presenting more irregularity of surface.—*From Dr. Lardner's Article on the Great Western Railway Inquiry, in the Monthly Chronicle.—London Mechanical Magazine.*

RAILWAY RECEIPTS.—Railway travelling generally seems greatly on the increase, and we understand the receipts of the Birmingham Company are now above 13,300*l.* per week, or at the rate of 700,000*l.* per annum. On the Newcastle and Carlisle railway, also, the traffic is so much increased that the Directors are laying down another line of rails [one line only having been laid in the first instance as now proposed for the Exeter railway to Bridgwater], as they find it absolutely requisite to accommodate the public.—*Bristol Journal*

According to the *Augsburgh Gazette* of 7th June, the preparatory works of the railroad between Pest & Presburg advancing rapidly, and the shares of the enterprise were in great demand.

WISCONSIN TERRITORY.—It is possible that, by this unauthorised publication of a business letter, we are depriving our readers of valuable and interesting facts promised by the writer, yet we trust not—as our only object in laying this before them is, *first* to disseminate correct information—as we are sure what comes from the writer of this letter may be implicitly relied on—and secondly, as a *modest hint* to numerous other gentlemen,—may we not say friends?—engaged in promoting the great cause of Internal Improvement—that we have strong, and we think *just*, claims on them for similar acts of courtesy. It is not for us alone, however, but our readers, that we urge C. N. H. and every other reader of the Journal to communicate such facts and general information, as may promote the cause in which we labor.

For the American Railroad Journal and Mechanics' Magazine.

EXTRACT FROM A LETTER, DATED

RACINE, RACINE CO., WISCONSIN TER., August 15, 1839.

Enclosed is the amount of my subscription for the present year, commencing with volume 9th., (new series, vol. 3, No. 1.)

I wish, hereafter, my numbers to be forwarded to this place, well enveloped in thick paper, as our mails have often to encounter very rough roads, and in some instances running streams of water, which endangers their safety.

My time has been, while in the territory, too much taken up with the duties of my profession, to allow me to give any notes, memoranda or statistical facts relative to the Internal Improvements projected here. Indeed, the territory is too new, as yet, to enter largely into these matters. I am now engaged in the construction of a common road extending completely across the territory, from Racine on Lake Michigan, to Sinepee on the Mississippi, through the southern tier of Counties. An appropriation of $10,000 was made by Congress, at its last session, to aid in its construction. Capt. Cram, of the Topographical Engineers, has the general superintendence of all the Internal Improvements projected by the government in the territory. Appropriations have been made by Congress for a road from Milwaukie through Madison, (the seat of government) to the Mississippi, ($10,000 appropriated.) This was expended last winter and this summer, on the portion of the road from Milwaukie to Madison. Other appropriations for roads, for survey of Rock River, and for survey for Railroad from Milwaukie to the Mississippi, were made by Act No. 74, (public) 2nd Session of 25th Congress. Another Act of March 3d., 1839, (3d. Session of 25th Congress) made other appropriations for the territory. These common roads are just now of the utmost importance to the growing interests of this garden spot of creation—and Railroads and Canals must for the present be superseded. The Milwaukie and Rock River Canal, however, is one of great importance to the territory. A grant of land was made by Congress, to the territory, to aid in its construction. Mr. Byron Kilbourne

is the President of the Company, Mr. J. Lapham its Engineer. Mr. Alexander Mitchell, late of the U. S. Army, is the territorial Engineer and has been charged with the necessary surveys and examinations for the Canal route, and it has been finally located, ground broken on the 4th of July last, and certain portions are about being put under contract. I will try and send you a copy of the Canal bill as passed by the territorial Legislature last winter, and if any reports of the Company can be obtained, I will forward them to you.

I will soon, if possible, give you an analysis of the agricultural and mineral resources of the territory, its Internal Improvements, &c., &c. Mr. Wm. Jackson, who removed from your city last fall, and is a promising young lawyer, settled now at Mineral Point, will publish, this fall, a work on the resources of Wisconsin, which will, I think, give a graphic delineation of our prosperous territory. Obtain a copy—it will show how we are driving ahead in a spot which three and a half years ago, was ranged by the roving bands of Winnebagoes Menomonies and various other tribes, and which was in 1832, the scene of the celebrated Black Hawk war, when but few settlers were to be found—the only white men then here, being Indian traders or mineral diggers, in the western portion of the territory. A more fertile, healthy or beautiful country is no where to be found, than Wisconsin.

I have written the above in haste, but will soon give you a communication fit for publication. In the meantime, gentlemen,

I remain your obedient servant, C. N. H.

We find in the Railway Times the following notices of the evidence before the Select Commmittee on Railways. Although intended for another medium these remarks cannot but find their application with us. We have several times proposed to ourselves the subject of the "Minor morals of Railroads" and have as yet found nothing so much to the purpose as the following. We shall continue the articles, as found in the Railway Times.

In adverting last week to the evidence taken before the Select Committee on Railways, we expressed our firm belief that the object proposed by the Committee in recommending the insertion into all Bills then before Parliament of a clause bringing the undertakings to which they relate within the provisions of a future general Act, had reference to minor points of management rather than to any contemplated infringement upon the rights and privileges of the Railway Companies; and we stated at the same time that the evidence hitherto published appeared to point at the necessity of some uniform system in these comparatively trivial, but nevertheless most important, arrangements. We now proceed to notice a few of the details which range under this head, omitting until the production of further evidence, the consideration of one or two subjects which will be more appropriately treated of when the whole of the case laid before the Committee shall be developed.

One of the principal subjects which appear to have engaged the attention of the Committee, is that of bye-laws, with a view, it would seem, to the introduction of some uniform system, and to the supervision of some

competent tribunal. With respect to the former point, most of the witnesses express an opinion that uniformity would be highly desirable, while all of them agree in admitting that the establishment of a superintending power in this matter would be very advantageous to both parties, namely, the Companies and the public. The representatives of the Birmingham Company state that they are exceedingly anxious, instead of being left to the present uncertainty, to have their bye-laws defined, although they express a doubt whether it is possible for Parliament in this early stage of the Railway system to lay down such laws with sufficient precision. In like manner Mr. Moss, on the part of the Grand Junction Company, and Messrs. LAURENCE and BOOTH on that of the Manchester and Liverpool, although they state that these Companies have no bye-laws [forgetting that although not so in name, their travelling regulations are substantially the same], can see no objection to the supervision by some proper tribunal, and if necessary, the disallowance of such enactments. Mr. SIMS and Mr. SAUNDERS on the part of the Great Western Company are of the same opinion, and add, that in their Bill [then] before Parliament there is a clause the same as that which Mr. REED of the Southampton, states has been introduced into the Bill for the Gosport branch of that undertaking, obliging the Company to submit their bye-laws to one of the judges of the land, or one of the Courts of Quarter Sessions. This proviso is similar to one in the new Bill of the Birmingham Company, which renders it necessary that every bye-law shall not only receive the approval of a judge, but be published in the *Gazette* and two country newspapers, at least one month previous to coming into effect.

Closely connected with this subject, and flowing as it were from it, is the due management of the Companies' servants; and the Committee appear to have paid considerable attention to this branch of the inquiry, especially with respect to the engine-men, upon whom so much depends. The witnesses, particularly Mr. Moss, lament exceedingly the unfitness of many of the persons who engage themselves for this responsible duty, the great demand for engineers rendering it impossible for the Directors to find at all times, individuals fully competent. Mr. Moss recomends the appointment of a Government Board [to be paid by the Companies] whose duty it should be to examine applicants, and grant certificates qualifying them to take out licenses, in the same manner as pilots are examined by the Trinity Board, the Companies employing such persons not to be responsible for any accident occasioned by a disobedience of orders on the part of these licensed engineers, although liable in every other instance. At present, says Mr. Moss, the Companies appoint the best person they can get: he disobeys their orders, and the public come upon the Companies for damages. Mr. Moss meets an objection which might be urged against his plan, namely that this freedom from liability would render the Companies less careful whom they engaged, by recommending that the engineers should find security, which would render them more attentive, and states that the Companies would not be disinclined to allow a higher rate of remuneration to a better class of persons, which would render them afraid of losing their situations. Mr. CREED says the examination of engine-men has never occurred to him, but he is satisfied that every Company would be ready to adopt any arrangement which would give confidence to the passengers. All the witnesses represent the difficulty which the Directors have in keeping these engine-men to their duty, and Mr. LAURENCE refers to one occasion where the men left their employment *en masse*, and the Company were obliged to put up with the best substitutes they could find, to the great damage of the machinery, although fortunately no accident occurred. Several of the wit-

nesses are of opinion that the punishment of carelessness and other offences [such as leaving their employment without notice,] by the magistrates, independent of the Directors, would be of advantage. Mr. LAURENCE and Mr. SAUNDERS in particular, think that if engineers or persons engaged in a confidential capacity were to be taken before the petty sessions or some competent tribunal for neglect of duty, even though accidents should not have occurred, it would produce a strong moral effect upon them beyond that which now exists as to the necessity of attention.

The regulations of the Companies with respect to passengers suspected of contemplated fraud seems to have been much canvassed by the Committee. Such of our readers as have travelled on the Birmingham Railway will recollect that it is the practice to collect the fair tickets at the last station but one upon the line. A similar plan is followed on the Southampton line, whereas on the Grand Junction and Great Western Railways the tickets are collected before the train starts. This latter method is allowed even by those who follow it, to give room for much fraud; for, as Mr. REED observes with respect to the Southampton line, a passenger might take out an eighteenpenny ticket to Kingston, and as the guard of the train could have no means of knowing what ticket the passenger had, he might proceed for one shilling and sixpence to the end of the journey. To be sure there might be, as on the Great Western line, carriages exclusively set apart for particular stations, but then, as Mr. REED remarks, in answer to a suggestion of the kind, there might be only three or four passengers for that particular station, which would involve the necessity of taking a great many more carriages than need be. One disadvantage inseparable from the other plan is this, that a person wishing to defraud the Company cannot be detected until he has arrived at the end [or nearly so] of his journey, which is of course all that he desired. It was therefore deemed necessary by the Birmingham Company to enact a very stringent law on this point, rendering a person who could not, or would not, produce his ticket, liable to a penalty of 40*s.* in addition to the payment of the fare, and in default to be detained and taken before a magistrate. It has been objected to this regulation that it confers powers greater than those possessed by the proprietors of stage coaches in similar circumstances, and some members of the Committee appear to entertain considerable hostility to it. In the case of the Birmingham Company, however, all objection will soon be at an end, for in the new Bill there is a clause which does away with the penalty and only authorizes the Company to detain a passenger and take him before a magistrate in the event of his not either paying the fare or giving security for it.—With all submission we think the Railway Companies ought not to be reduced to the level of coach proprietors in this particular, but rather that the latter should receive more efficient protection against so disgraceful a species of swindling.

There is, it appears, an excellent arrangement in existence upon the Grand Junction Railway, the adoption of which the Committee seemed disposed to recommend. At every station there lies open upon the bar a book in which persons are requested to write down any complaint they may have to make, a copy of which book is laid before the Board at their weekly meetings without the power of concealment. With Directors determined to redress all grievances upon their line a plan like this could scarcely fail to ensure civility and attention from inferior officers. The same plan is nominally adopted in part on the Great Western line: that is, there is a book kept at Paddington, but it does not appear to be sufficiently, if at all, exposed, and no person has ever made an entry in it.

There are various other points to which the attention of the Committee

has been directed with a view evidently to some general enactment, such as the fencing of the several lines to prevent the straying of cattle; suitable compensation for damage by fire; the regulations affecting the transmission of carriages and horses; and the facilities for the running of other engines on the lines. To these we shall advert in a future number. There is, moreover, a good deal of evidence with respect to the establishment of a Royal Commission, but as the object contemplated in the institution of such a Board appears to be principally to decide upon the merits of competing lines, and to determine in cases of difference between Railway Companies and land owners, it cannot, of course, bear very directly upon the first Report of the Committee as affecting those Companies at present before Parliament for amended Acts. We shall, nevertheless, take an early opportunity of laying this part of the evidence before our readers, with some comments upon the scheme.—*Railway Times.*

THE RAILWAYS OF MASSACHUSETTS.—The Great Western Railway between Worcester and Springfield is fast being made ready for use. The rails are laid for the greater part of the whole distance, excepting for short intervals where vigorous operations are prosecuted for completing the grading and superstructure. It is expected that communication will be opened as early as the beginning of October.

The first division of this way, extending from Worcester to the height of land between the sea and the Connecticut river in Charlton, about 14 miles westward, has been constructed under the superintendence of Capt. J. Barnes, and has been for some time so far finished as to be traversed by the car propelled by *man power*. This portion exhibits a specimen of the magnitude of the great work. The country is broken with deep valleys, or thrown into ridges which seem to present almost impassable barriers. Yet the skill of the engineer has carried the iron-pathway over a surface so rugged and difficult as to appear impracticable to the eye uninstructed by the evidence of actual construction. The traveller sees the road, breaking through the hills and striding across the ravines, with equal admiration and astonishment at the boldness of the design and the success of the execution. The whole of the work is of the most excellent character; wide excavations through rock and earth, and long embankments sometimes rising more than sixty feet above the surface, the solid masonry and the firm structure, bear testimony of the excellence of the construction, and the power of human science and labor in overcoming the obstacles of natural difficulty.

West of the Connecticut river, it is understood that the road is under contract, and may be completed to the line of the State within two years.

The Norwich road is rapidly advancing. The cars now pass from Norwich to Plainfield, about twelve miles. Workmen are engaged in laying the rails from Worcester towards the south, and at intermediate points between the extremities. The whole road is graded, and it is said may be opened during the month of October, for travel over the whole extent.

The Eastern Railway will be extended to Ipswich in November next, and opened to Portsmouth by the 4th of July following.—*National Ægis.*

EASTERN RAILROAD.—This Railroad has now been opened for public travel one year. The Essex Register states a number of interesting facts, illustrating the success of the enterprise. It appears from this statement, that on the commencement of the work, the estimated number of passengers annually transported on the route was 116,700, of which it was estimated that 32,000 were conveyed to and from places beyond Salem, and

84,700 between Boston and Salem, Lynn and Marblehead, and that this number would be doubled by offering the advantages of Railroad travel.

The actual number conveyed on the Railroad, in the year from August 28, 1838, to August 28, 1839, was 287,000, or two and a half times the number estimated to be conveyed before the road was opened, and 55,000 more than it was estimated by the projectors of the Railroad, that there would be, when the road should be opened. The greatest number of passengers conveyed in any one day was 7,006, on the 4th of July last, and the next greatest number, 2,100 on the 5th. The greatest weekly travel was 13,937 in the first week in July, the next greatest 7,631 in the week ending August 24, and 7,531 in the last week in May.

The least weekly travel was 3,220, in the last week in December, and the next less 3,600 in the first week in February. The work for the extension of the road to Newburyport is rapidly advancing, and particularly the tunnel for carrying it under the central part of the city of Salem.—*Advertiser.*

By the preceding paragraphs from eastern papers, we learn what Massachusetts is doing in the way of extending her works for securing the business of the West, and facilitating travel to the East.

The natural inquiry of a reflecting New Yorker, on reading them is—what is New York doing? To which he may, with truth, as well as deep mortification, reply—New York, the Empire State, is engaged in *putting men out of, and into office!*

SEMI-ANNUAL REPORT OF THE DIRECTORS OF THE LA GRANGE AND MEMPHIS RAILROAD COMPANY.

(Continued from page 64.)

Contingencies.

Printing account,	569 39	
Postage account,	20 82	
Office expenses, including rent, firewood, stationary, &c.,	235 31	
Other contingencies, including salaries of officers, &c.,	8,186 10	
		9,011 62
Profit and loss, interest on sundries, &c.		2,884 78
		$190,279 61
Total amount of receipts as above,		$181,933 12
Disbursements as above,	$173,311 22	
Cash on hand, July 1st, 1839,	95 00	
Notes on hand,	7,546 00	
		181,933 12
The Company owe in Notes, payable in the banks at Somerville, Memphis and La Grange, and to individuals,		$32,430 00
Due to individuals, not closed by note,		16,131 33
Per centage retained, which will fall due when the contracts are completed,		15,833 00
		$64,394 33

We have on hand---Cash,	$95 00	
Due from banks state bonds on deposit and from individuals, on account,	46,765 00	
Notes of individuals,	7,546 00	
All of which, if available, would more than pay the debt now due, but including the per centage retained, would leave a deficit of	987 83	
		$64,394 33

Besides the assets above mentioned, we have due from individual stockholders, including interest upon the stock, $165,690 00
State Bonds now due, 31, 250 00

$196,940 00

From the above must be deducted the insolvencies and unavailable credits.

The actual cash transactions for the last half year have been very limited. The amount on hand on the 17th January last, was $1,000 00
Received from the 17th January to July 1st, 1,741 87

$2,741 87

Paid out from 17th January,	$2,645 87	
Cash on hand, July 1st,	95 00	
		$2,741 87

To the debts may be added the estimates of the second quarter, which had not been audited when the Cashier reported, together with the expenses of laying the superstructure, (for which see Engineer's report.)

At the organization of the present Board, in January last, the debts against the Company, including the estimates of the last quarter of 1838, amounted to about $85,000, four-fifths of which constituted an immediate demand on the Treasury. To sink this debt was our first consideration. Accordingly a negociation was opened with the banks for a temporary loan; which resulted in obtaining from the Farmers and Merchants' Bank of Memphis $14,500, at 8 per cent., payable 9th March, 1840, the Company executing its corporate notes and depositing State Bonds as collateral security:---From the Branch of the Bank of Tennessee at Somerville, $12,261, at 6 per cent., payable 1st November next, on company's notes with endorsers, and filing Bonds to that amount as collateral security; and from the Branch of the Planters' Bank at La Grange $1000, at four months, upon the same terms,*----making $27,761. These sums, with the collections from stockholders, State Bonds, and the transfer of debts and accounts to contractors, &c., at a small discount, enabled the Directory to keep up the disbursements with the accumulating debts, or nearly so.

Every effort will be made to finish 15 miles this year. Col. Charles Potts, the Chief Engineer, proceeds to Philadelphia to negociate for the Railway Iron, Locomotives, &c. Our reliance to purchase materials, mainly depends upon the sale of our State Bonds, and the interest being payable at Nashville, they are not at par in the Northern market; five and a quarter per cents, payable at Nashville, being not quite equal to five per cent. bonds payable at New York. The propriety of applying to the Legislature for the privilege of surrendering the present bonds, and obtaining others, with the privilege of directing the payment of the interest at any

* It is due to the Planter's Bank to observe that she had previously purchased State Bonds at par to the amount of $31,250, and proffered to loan us $3000, which she considered was equivalent to the accommodation of the other two Banks.

point the Board should designate, is respectfully recommended. If the interest on our Bonds was payable in London, they would now command a premium.

We cannot close this report without alluding to another matter which has served to embarrass our movements. We are threatened with a very unexpected bill of expense for the right of way. When the Road was ready to let, at the close of the year 1836, the enthusiastic public spirit, which seemed to pervade the whole community, forbid the idea that exorbitant damages would be claimed by any of the proprietors of land on the route. And such was the anxiety to proceed with the grubbing and grading, that few releases were obtained prior to the permanent location of the Road. The consequence has been, that we have been placed in an unequal position to all those who imagined themselves agrieved, and compelled generally to submit to the assessment of a jury of five, without many of those guards which protect as well the rights of corporations as individuals, in the ordinary mode of administering justice. That a few proprietors have sustained slight damage by the Road, is probable; but nine-tenths of them are unquestionably benefitted. And it behoves every liberal minded citizen, to discourage these extortionary claims. There is not a tract of land on the whole line that has not advanced in value from 25 to 100 per cent. in consequence of the location of the Road through it. No fact is more generally admitted. And how any person can expect to obtain damages for benefits conferred is a mystery. The charter expressly provides that the jury shall take into consideration the benefit the Road will be to the owner and the tendency it will have to increase the value of the land.

The Charleston and Hamburg Railroad, 136 miles in length, did not cost the Company a cent—and we are mortified that we cannot bear testimony to a similar liberality. Respectfully submitted,

EASTIN MORRIS, *President.*

La Grange, July 23, 1839.

ENGINEER'S REPORT.—TO THE PRESIDENT AND DIRECTORS OF THE LA GRANGE AND MEMPHIS RAILROAD.—*Gentlemen*:—It gives me great pleasure, in the discharge of my duty, to be able to report to you at your present meeting the favorable progress with which the construction of the Road is going on, particularly that portion of it laying between Germantown and Memphis. The hands which have been hired and set to work laying down the superstructure, now that they have become initiated and acquainted with the respective duties assigned them, are now laying down, upon an average, a rod per day to each hand on the job. Although the circumstances under which these hands were collected and hired, were such as to make it necessary to pay the highest wages for them, the result notwithstanding shows the measure to be decidedly more economical than would otherwise have followed by the acceptance of any of the propositions from individual contractors. The laying down of the railing was commenced on the 21st of May last with about 15 hands, and has been going on since that time without other than the ordinary intermissions, the number of hands, however, increasing daily. On the 24th of June the number was 32, including boys and women, which is the number at present, no further addition having been made since that. From the 21st of May to the 24th of June, there was laid down 388 rods of the superstructure, and the number of days work required to complete this amount of work was 596, making an average of 65-100ths of a rod per day to the hand. It will be understood that this average embraces the time, when all the hands

are wasting much of their time in learning and acquiring a knowledge of a business entirely new to them. For the last month the hands have so improved as to average per each hand a rod per day. The work, also, is well put together; and I cannot omit this opportunity to express to you my entire satisfaction in the ability and energy with which Capt. Wollard has discharged his duties as superintendent of this portion of your important work. That you may form some estimate of the economy in laying down the superstructure as now pursued, I have addded the following calculations:—We now have 32 hands on the Road engaged in laying down the Railing and other duties appertaining thereto, which cost us for their time 24½ dollars per month. The Superintendent receives 52 dollars per month. The keeping of the hands may be estimated at 8 dollars per month each. The other contingent expenses may be computed at 150 dollars per month. The Company having no teams of their own it becomes frequently necessary to hire them during the month for hauling and for other purposes. Hence the expenses, per month, will stand thus:

32 hands at 24 1-2 per month,	$784 00
1 Superintendent,	52 00
33 hands boarding, at 8 per month,	264 00
Contingencies,	150 00
Total,	$1250 00

I have already stated that the hands now lay down about one rod of track per day to each hand, or about 700 rods per month in the aggregate. Hence it cost the Company $180, nearly, per rod. This is one dollar per rod less than the lowest bid that has been laid before you for acceptance. The Superstructure that has been laid down has been of Cedar timber. It cannot be expected that the same progress will be made when the Oak is to be handled and put down. A proposition is herewith presented from Mr. Coe, of Somerville, to lay down a portion of the Superstructure. I should not consider Mr. Coe's proposition out of the way, if the filling up of the track was included. He would be required to work upon the Oak timber altogether, and as much of this timber is very much warped and sprung, considerable time and labor would be required to redress it so as to put it together in a workmanlike manner.

Respectfully submitted, by your most obedient,

CHARLES POTTS.

La Grange, July 17th, 1839.

THIRD SEMI-ANNUAL REPORT OF THE ENGINEER OF THE CENTRAL RAILROAD AND BANKING COMPANY OF GEORGIA, TO THE PRESIDENT, DIRECTORS AND STOCKHOLDERS.

ENGINEER'S DEPARTMENT OF THE CENTRAL RAIL-ROAD, May—, 1839.

To W. W. Gordon, Esq., President.

SIR—I have the honor to present you with the third semi-annual Report of the condition and progress of the work under my charge.

Since the date of my last report, contracts for grading have been extended to a point 133 miles from the city, and opposite the town of Sandersville, which place the road approaches within four miles.

The road bed is completed for a distance of 114 miles, and a contract is made for a bridge over the Ogechee river.

The track is laid, and the road completed 76 miles, and the laying of

the superstructure is in constant progress, at the rate of about one mile per week.

The site of the 80 mile depot has been designated, and preparations are now making to erect a large store-house for the receipt and forwarding of produce and merchandise. This will be completed early in the month of July.

The buildings at the depot in this city are in a state of forwardness, and will be urged on to completion as rapidly as materials can be procured.

By a reference to the last report, you will perceive that 35 miles of grading, and 30 miles of superstructure, have been accomplished within the last half year.

The line will be definitively located and ready for contract to the Oconee river, a distanee of 148 miles, in six weeks from the present time.

It affords me pleasure to inform you, that the tedious and laborious examinations of the country from the Sandersville summit to the Oconee river, have resulted in the discovery of a line, altogether more favourable, both in respect to allignment and cost of construction, than we had reason to expect. We make the descent to the Oconee valley, as I have before mentioned, by means of one of the prongs of Sand-Hill creek. This stream has many branches, which flow out of a section of country very broken and hilly. It was indispensable that several of these branches should receive an instrumental examination, in order to obtain full data for a judicious selection. This labor has been most thoroughly performed; and every route presenting any claims to favor, has been examined.

To ensure the adoption of the most advantageous position for every part of the line, in a country of such complicated topography, it was deemed necessary to run cross sections at short intervals throughout the whole extent of the valley, which, when laid down on a map, would present a perfect analysis of the topographical features of the section under examination, and afford the data for projecting a location, without the least apprehension of overlooking the most advantageous route of which the country was susceptible.

I am perfectly satisfied from experience, in several instances in the course of the surveys for this road, that a great saving may always be made, and great improvements in location, by pursuing the above plan in all complex and difficult portions of the line.

The surveys of the line from the Oconee to the Ocmulgee had just been completed at the date of my last report. The maps, profiles, and estimates were soon after made up, and the result will be found in a subsequent part of this report. I will however remark, in relation to that portion of the line, that, as much of it is of a character similar to the line down Sand-Hill creek, a similar course will be pursued in making the final locations; and we may reasonably expect that in establishing the line with precision, many improvements may be made.

Our final location to the Oconee river, shortens the distance to that point from previous surveys, three miles; making the total distance to Macon 193 miles, provided no change is made in the length of the line between the Oconee and the Ocmulgee rivers.

The precise direction in which the line will enter the city of Macon, has not been determined. It is presumed that no benefit would result from hastening the decision of this question.

I am satisfied that in the excavation of the western division of the line, no rock will be encountered, and that for the most part the earth will be of easy removal.

In the grading, we have during the last half year, been as usual on this

work, fortunate in having contractors generally responsible and faithful, I am pleased to be able still to say, that we have not, since the commencement of the work, had a contract forfeited or abandoned before completion.

A few weeks since, some disturbances originating from sectional differences among the labourers; interrupted for a short time, the harmony which had previously prevailed throughout the line, this has led some of the contractors to resort to the employment of blacks altogether; and I am much pleased to perceive a disposition on the part of several of the planters residing along the line, to engage in contracts; I have no doubt the effect will be, to enable us for the future to keep up a more uniform scale of operations during the whole year, and also to render the work more popular, by diffusing the benefits attending its construction, more generally among our own citizens, than if the labor were performed by strangers.

That negro labor is perfectly adapted to the construction of works of internal improvement, is now a well established fact; and when this fact comes to be more generally acted upon, the public works of this section of the union will be placed on a basis that will, in a great degree, exempt them from the effects of the fluctuations and vicissitudes in the financial affairs of the country, so detrimental to such undertakings elsewhere.

So far as my knowledge on the subject extends, I have found that such of our citizens as have engaged in contracts, have, in nearly every instance, realized fair profits, and have generally been desirous of continuing in the business.

In relation to our plan of superstructure, I am still satisfied that we have adopted the best mode of applying the "plate rail."

It gives me pleasure, however, to say, that in the late resolution of the Board, adopting and ordering a large quantity of the edge rail of the inverted T pattern, they have obviously consulted the best interests of the Company; for although examples are not wanting to show, that a good road, capable of sustaining a great amount of transportation, may be made with the flat bar,—yet it is almost universally conceded, that the extra cost of the edge rail is amply repaid by the saving in repairs of the road and machinery, and by the increased comfort to the passengers.

We propose to use this rail in connexion with our present longitudinal timbers—to be laid along the centre of the top surface, and confined by chairs at the joinings, and intermediately by brad spikes. Having a string piece of so large dimensions, we are enabled to use a rail of much less weight than when it is laid only on cross ties. The rail we have adopted will weigh about 32 lbs. per yard, or about 51 tons per mile, exclusive of chairs and spikes. The wooden structure to be the same as at present, excepting the top ribbon. *For a description of it, see first report.*

The iron already on hand will extend the track about 100 miles. An additional quantity is ordered to be delivered in the fall, sufficient to reach about 40 miles further, and as the grading for that distance will be finished by the time the iron is received, we may reasonably expect the road to be in use from 135 to 140 miles from this city early in the next season.

The following shows the expenditures on account of the road up to May 22d, 1839:

For Engineering,	$90,334 18
Grading, including bridges and culverts,	474,238 41
Superstructure,	110,312 20
Iron rails, spikes and plates,	150,565 33
Right of way, houses and lots,	12,634 50
Carpentry,	19,864 68

Smithry,	12,026 59
Negroes,	922 25
Locomotive Engines.	31,241 31
Lumber,	27,924 32
Iron for Smithry,	17,409 21
Teams and Forage,	18,645 33
Expenses of Transportation,	4,193 53
*Repairs of road,	2,433 36
Implements,	27,187 64
Railroad Cars,	16,729 34
Depot at Spring Hill,	4,108 78
Brick yard,	1,624 25
Incidental Expenses,	31,000 10
Total amount expended,	$1,053,395 31
Of the above amount the Company have on hand Teams, Implements, Forage, Provisions, Lumber, Iron, Coal, &c., say $10,000	10,000 00
Nett expenditure,	$1,043,395 31

As I have before remarked, the work, for the first 17 miles, was done on the Company's account, and in the several items of cost in the foregoing table, that portion of the work is of course blended with the part which has since been done by contract.

The following is a statement of the cost of the grading and superstructure, exclusive of iron from the 17th mile upwards:

Grading———	Excav'n and embank't	224,704 66	
	Grubbing and clear'g,	30,501 80	
	Culverts and bridges,	12,524 20	
	Road crossings,	689 75	$268,420 41
Superstructure—	Timber,	55,443 37	
	Laying and filling track, including turn outs and Water Stations,	43,307 79	98,751 16
Right of way,			5,985 45
			$373,157 02

The following is an estimate of the cost of the whole road, including expenditures already made, and the amount required to complete it to Macon.

That part of the line between the Oconee and the Ocmulgee, as I have before remarked, has only been approximately located, and it may be expected, that on a definite and careful location, such improvements may be made as to reduce somewhat the cost. I state the estimate, however, without making any allowance for improvements:

ESTIMATE.

Amount already expended,		$1,052,395 00
Amount required to complete the grading to the end of present contracts, 133 miles,	93,000 00	
Timber for superstructure,	55,000 00	
Laying do. and filling track,	45,000 00	

*This item of repairs is occasioned by having to re-lay a portion of the track, in consequence of first using connecting plates of Cast Iron, which were found to be unfit for the purpose.

Iron for 34 miles, [edge rail] - -	122,400 00	
"Turn outs" and Water Stations, - -	2,500 00	
Right of way, say - - -	3,000 00	$320,900 00
To complete the grading from the end of present contracts to the Oconee river including bridge over that river, [15 miles] - - - - -	108,262 00	
Land damages, say - - -	1,000 00	$109,262 00
Grading from Oconee to Ocmulgee, [45 miles.]		
Excavation and embankment, - -	332,775 00	
Culverts, - - - -	11,346 00	
Bridges, including one over Ocmulgee,	23,000 00	
Grubbing and clearing, - -	17,507 00	$384,628 00
"Turn outs" and Water Stations, - - -		5,000 00
Land damages, say - - - - - -		10,000 00
Superstructure 60 miles, with edge rail, at $6,400 per mile, - - - -		$384,000 00
		$2,267,185 00
Add for Engineering and contingencies, - -		32,815 00
Total estimate, - - -		$2,300,000 00

In the various schemes and speculations that have lately been presented to the public, on the subject of the channels to be taken by the South-Western trade of this Union to reach the Atlantic, it has been customary to leave this Railroad entirely out of view. Whether this has been induced by a belief that the road itself would not afford a means of conveyance for the produce, merchandise and passengers, equally good with other projects in vogue, or whether it has arisen from a supposition that the city at its eastern terminus is not an eligible place for the great mart and depot of the South Atlantic States, or from a combination of both these causes, I am not able to say; but lest such an impression may have found its way into the counsels of the advocates of internal improvement, we will examine the merits of the route of which this road is to form an important part, and compare it with others at present occupying the attention of the public.

It has long been considered a desideratum to effect an internal communication by means of a Railroad, between the State of Ohio and a Southern Atlantic port. Charleston has been selected as the great port of debouche, and two routes have been before the public, in a position of rivalry for effecting this great communication. Both are common as far as Knoxville in Tennessee; here they diverge; the great Louisville, Charleston and Cincinnati route takes the French Broad river, and passing through Ashville, N. C., and Columbia, S. C. joins the South Carolina Railroad at Branchville, and pursues that road to Charleston, making a total distance from Cincinnati of about 720 miles. The other route, which we will call the "Georgia route," pursues the Hiwassee Railroad to the Georgia State line, thence by the Westernand Atlantic Railroad it reaches De Kalb county, thence by the Georgia Railroad via Madison and Greenborough to Augusta, and by the South Carolina road, it ends at Charleston---distance from Cincinnati about 750 miles.

These two, have hitherto been considered the great rival routes; but, as

the probability of the Louisville, Charleston and Cincinnati road being continued farther than Columbia, S. C., appears to be fast fading away, the "Georgia route" is left in possession of the field, unless the route via Macon to Savannah, is found to possess sufficient advantages to entitle it to a claim to public favor. We will designate this last as the "Central route," and make a brief comparison between it and the "Georgia route."

Taking the eastern terminus of the Western and Atlantic Railroad in De Kalb county, as a common point, the distances respectively to Charleston and Savannah, will be as follows:

GEORGIA ROUTE.

From the eastern terminus of the Western and Atlantic Railroad in De Kalb county—

To Madison, - -	Georgia Railroad.	65	
From Madison to Greensborough		25	
From Greensborough to Augusta		79	
From Augusta to Charleston,	S. Carolina R. R.	137	306

CENTRAL ROUTE.

From the eastern terminus of the Western and Atlantic Railroad in De Kalb county—

To Forsyth, - - -	Monroe Railroad.	69	
From Forsyth to Macon, -		25	
From Macon to Savannah, - -	Central Railroad.	193	287
Difference in favor of Central route, - -			19

This difference in distance is so small as to be of little consequence. Let us however carry the comparison a little further, and examine the relative capacity for transportation, &c., of the two routes.

The Central Railroad presents an uncommonly favourable profile having no inclination of grade exceeding 30 feet per mile, and no curvature on a less radius than 2000 feet. The allignment consists for the most part, of straight lines; in some instances 16 miles in extent—and is in all other respects, capable of sustaining as much trafic as any other Railroad in the Southern States.

The Monroe Railroad is finished, and now in use from Macon to Forsyth, 25 miles, and is similar in point of allignment and grades, to the Georgia Railroad. The remainder of the distance to the State road in De Kalb county, is known to possess uncommonly favorable features for a Railroad route. Taking the "Georgia route,"—the South Carolina Railroad, although generally free from frequent curvatures, has several of less radii than 2000 feet. The maximum of inclination of grade is 36 feet per mile, and the road is moreover burdened with an inclined plane requiring a stationary steam engine.

The Georgia road has a great number of curves, and a small proportion of long straight line, though none of the curves are on radii of much less than 2000 feet. The road is in all other respects excellent—completed as far as Greensborough, 79 miles. The distance thence to Madison, 25 miles, is under contract, and it is presumed may be compared with the part finished as to grades and curves. From Madison to the Western and Atlantic road, the route is most difficult, and the construction will be very expensive, though it is supposed a location is practicable without exceeding an ascent of 36 feet per mile.

To compare the cost of the two routes, the "Georgia route" may be estimated as follows:—

From the eastern terminus of the Western and Atlantic road to Madison,	$1,200,000	
Madison to Greensborough,	600,000	
Greensborough to Augusta,	1,200,000	
South Carolina Railroad,	3,000,000	$6,000,000
CENTRAL ROUTE.		
Central Railroad,	$2,300,000	
Macon to Forsyth,	450,000	
Forsyth to Western and Atlantic road,	1,000,000	$3,750,000
Difference in favor Central route,		$2,250,000

In the above statements, great accuracy either in distances or amounts, is not aimed at; but whatever errors there may be, will not affect materially the result of the comparison.

It will of course be admitted that the expense of keeping the roads in repair on the Central route, will not exceed that of the other, as the proportion of deep cutting and heavy embankments, is far less on the former than the latter.

It follows then, that with the same amount of business; the stockholders of the Central route may reduce their rate of freight, to at least one-third less than those of the Georgia route, and realize equal profits.

In relation to the merits of the city of Savannah as a commercial mart, I will only remark, that the bar at the entrance of the river is not excelled by any south of the Potomac. I have seen ships drawing 20 feet water pass over it.

The city is less than 20 miles from the ocean, and ships carrying 2000 bales of cotton have loaded at the wharves, and by dropping down 3 1-2 miles may take in 2800 or upwards.

It is indeed unnecessary to say more in favor of Savannah as an outlet for the great Southern staple, than to mention the fact, that her exports of cotton have for several years past exceeded those of Charleston, by many thousand bales per annum.

On the score of health, it may be confidently affirmed, that no city in the Southern States can show more favorable bills of mortality in proportion to the population, for the last twelve years, than the city of Savannah.

A charter was granted at the last session of the Legislature, for a branch Railroad to connect this road with the city of Augusta; and in compliance with a request from a committee of the citizens of Burke county, a survey was made under the direction of this department, for the purpose of ascertaining the cost, &c. of that portion of the route between the Central Railroad and Waynsborough. A report with estimates and maps in detail, shewing the result of this survey, was communicated to the above named Committee. As that report has not been published, the following synopsis may be made:

The route surveyed diverges from the line of the Central Railroad about 3-4 of a mile below the point where this road crosses Big Buckhead creek, and pursues the general direction of the valley of this creek for about 13 miles, to Rosemerry creek—here bending to the right it assumes the dividing ridge between the waters of Buckhead and Briar creek, and follows this ridge over a moderately undulating country to Waynsborough.

The distance is 22 1-2 miles—which, added to the distance from the point of junction to the city of Savannah, 79 miles; and the distance from Waynsborough to Augusta 32 1-2 miles—makes a total distance of 134

miles from Savannah to Augusta by Railroad, being only 12 miles longer than the direct stage route.

There will be no inclination of grade exceeding 30 ft. per mile, and no curvature on a radius of less than 2000 feet.

The cost of the road from the Central Railroad to Waynsborough is estimated at $182,800, exclusive of Locomotive Engines, Cars, &c.---and contemplating a superstructure similar to that of the Central road, with a plate rail supported by longitudinal string-pieces.

The citizens of Savannah, by an unanimous vote in town meeting, requested the corporate authorities to subscribe $100,000 to the Capital Stock of this road---and should the city of Augusta take a like sum, there is every reason to expect that the large resources of the county of Burke, and the public spirit of its citizens, with those of the two cities, will supply the remainder of the required funds, and that we shall soon see this branch in progress.

That it would be of great advantage to the cities of Augusta and Savannah and the intervening county, and add greatly to the business of the two Railroads already in progress, no one will doubt, and that the estimated cost bears a small proportion to the great advantages and revenue that might be expected, will also be readily admitted.

In thus enumerating the advantages to be reasonably expected to result from the completion of the Central Railroad, it is with a view of showing to the Stockholders, that although they have to traverse a great extent of barren and unproductive county with their road, before they can reap large returns for their investment; yet the cost of making the road per mile, when compared with that of most of the railroads in the country, is very small, and the road will be maintained at a small cost, as there are very few heavy cuts and embankments; and as the tolls are in proportion to the miles travelled—the great length of the road in proportion to the capital invested, will be an advantage in the end.

There is good reason to expect, that when we shall have finished the road as far as we now have it under contract, it will pay a good interest on the investment, and that the time will soon come, when it will be as profitable to its Stockholders as any road in the Southern States.

Preparations are being made for the opening of a large transportation business in the fall. We have now five Locomotive Engines, and expect two more by the first of September, and a sufficient number of Freight and Passenger Cars will be provided, to meet any amount of business that may offer.

I am, sir, very respectfully, your obedient servent,

L. O. Reynolds, *Chief Engineer.*

ANALYSIS OF SAND STONE.—ON THE CORRECT METHOD OF ASCERTAINING THE RESISTABILITY OF STONE TO FROST, TRANSLATED FROM THE GERMAN OF DR. BUEHNER, PROFESSOR IN THE UNIVERSITY OF VIENNA.

The means of ascertaining the capability of resistance of stone against frost occupied the attention of scientific men at an early period; but, although some recent communications have been made on the subject, they are but reproductions of the experiments of the mineralogist Brard. His system, which is that of subjecting stone to the action of Glauber salt, so as to produce a low temperature, has long been adopted as a universal medium in most countries of Europe, and sanctioned by many high authorities. It is truly observed, however, by Professor Fuchs, in Erdmann's Journal, that

such a mechanical method is of no more certainty than to rasp the stone with the finger nail, or strike it with a hammer, and that the only competent test is to subject it to chemical analysis.

The builders employed on the royal works at Munich have, in the course of their extensive practice, resorted to this process of analysis in preference to the usual method, and the following is an acoount of the experiments of M. Stumb, principal builder in that city:—

On the occasion of repairing the weather side of the tower of the Lady Church, at Munich, he instituted an examination into the sandstone of Waakirchen, in the district of Wiesbach. This sandstone is of a bluish grey colour, equal and fine grain, noways splintery, of moderate hardness, and giving sparks when struck with steel. On a closer inspection, minute specks of mica and quartz may be perceived.

A piece of this stone, weighing 30 5-8 ounces, was laid in distilled water for 24 hours, and on being taken out and weighed, it was found to have increased 6 grains, hardly two per cent., and affording a good proof of its closeness of formation, and small power of absorption.

The water in which the stone had been laid was evaporated to an ounce, and a yellowish residuum obtained, which, on being subjected to reagents, was found to consist of sulphate of lime and sulphate of soda, mixed with organic matter.

A piece of the sandstone was pulverised, and 100 grains of it treated with muriatic acid, and a partial dissolution effected by the development of carbonic acid gas. The remaining acid having been renewed by evaporation, the residuum of quartz sand was washed and cleaned with warm water, and found to weigh 57 grains.

The muriatic residuum was subjected to nitrate of ammonia, whereby alumina was produced, with a portion of oxide of iron. It weighed, on careful trial, 3 1-2 grains.

The solution filtered from the aluminous precipitate was treated with oxalic ammonia to produce deposition of the lime, which was exposed to the fire to convert the oxalate of lime into carbonic acid gas, and by which 24 grains of carbonate of lime was produced. The fluid filtered from this was acted upon by phosphate of natron, and a precipitate of phosphate of ammonia and magnesia appeared, which by heat was reduced to neutral phosphate of magnesia, which was calculated as 13 per cent., of carbonate of magnesia.

The composition of the stone was, consequently,

Quartz - - - - - -	57
Alumina - - - - - -	3-5
Carbonate of lime - - -	24
Carbonate of magnesia - - -	13
Loss - - - - - - -	2-5
	100

From these results it was proved that the sandstone of Waakirchen was a good building material, and fully capable of resisting the effects of air and water, as its component parts were not liable to decomposition, and its texture did not admit the introduction of their mechanical force.

It is evident that it is only by such trials that the true qualities of materials are to be ascertained, as mere mechanical action, or a trial of temperature, affords no criterion of the chemical constitution by which injuries of weather are caused.

EXPERIMENTS ON THE POROSITY OF A MASS OF COTTON.

TO THE EDITOR OF THE JOURNAL OF THE FRANKLIN INSTITUTE.

Sir:—

Perhaps you may consider the following pretty experiment on porosity, worthy of a place in your Journal. Fill a common glass tumbler, or other vessel, completely with some spirituous liquor, so that a few drops more would cause it to overflow. This done, you will find no difficulty in introducing into the tumbler, so filled, *a whole handful of raw cotton.*

This experiment was suggested by the accidental recovery of some wet cotton from a boat which had been sometime sunk in the Tennessee river; it was found by the workmen that after they had squeezed out the water from some cotton, the vessel in which it had been contained, remained nearly as full as before the cotton was removed.

Spirits answer better than water, for trying the experiment, from the rapidity with which they are absorbed by the cotton. Several theories were started by persons who tried the experiment; such as, that the filaments of cotton occupied the vacancies between the globules of water; or that by its capillary action, the cotton subdivided the globules, and caused them to occupy a less space, &c.; to me, however, it appears to be accounted for more satisfactorily, by supposing the fluid to insinuate itself between the filaments of cotton, and thus permit the latter to occupy no more space than is due to their actual solidity. The experiment is certainly a beautiful one.

Very respectfully, yours, &c.,

JOHN C. TRAUTWINE.

Knoxville, Tennessee, June 12, 1839.

OHIO CANALS.—A statement of the amount of Tolls collected on the Ohio and Miami Canals, for the month of June, 1838 and 1839.

	1838.	1839.
Akron,	2,445,13 0	2,158,46 0
Circleville,	4,821,58 0	3,346,69 0
Chillicothe,	4,044,74 1	6,527,83 0
Cleveland,	10,878,92 0	20,327,20 0
Columbus,	2,848,59 0	2,687,15 0
Cincinnati,	1,171,03 0	3,292,91 0
Dover,	3,128,22 5	4,197,55 0
Dayton,	474,70 0	1,980,64 0
Hamilton,	none.	117,08 0
Massillon,	3,512,27 5	2,802,34 0
Middletown,	none.	544,10 0
Newark,	18,483,26 0	10,166,41 0
Portsmouth,	5,073,00 3	4,430,83 5
Piqua,	10,99 0	134,85 0
Roscoe,	8,032,18 5	5,073,95 0
Total,	64,924,62 9	67,836,99 0
		64,924,62 9
Making an increase for 1839 of		2,912,36 1

SPECIFICATION OF A PATENT GRANTED TO NATHANIEL WORSDELL, OF LIVERPOOL, FOR IMPROVEMENTS IN APPARATUS TO FACILITATE THE CONVEYANCE OF MAIL BAGS, AND OTHER PARCELS, ON RAILWAYS OR ROADS.—*Sealed, January 4th,* 1838.

At present, in taking up or leaving mail bags, or other parcels, conveyed

by railway or railroad carriages, it is necessary to stop the train of carriages or so much to reduce the speed of the train, that the person at the station may hand up the bags, and that the guard may deposit the bag, or bags, to be left, on the ground, or with a person placed to receive them. And according to both these means, much delay necessarially takes place in the conveyance of mail bags, as well as loss of time to the whole train. And further, when the speed is only reduced, [in place of stopping the whole train of carriages] the bags are liable to be missed by the guard, and such has often been the case, and the bags have fallen to the ground; and in addition to the delay caused by the stopping of the train, and backing the same to the spot where the bag had been left, or otherwise waiting until the same is brought to the train, the bag has, in some instances, been found to be materially injured, and cut, by the wheels passing over it. And from this reason, in case the stations were numerous along a line of railway, which it is very desirable should be the case, in order to give the utmost extent of quick communication, the time lost, even in diminishing speed to take up and put down letter bags, and again to get up the speed of the train, when compared with the whole running time of the train of carriages between two places, would be found to be a most serious loss of time, and will be found to offer almost a barrier to numerous stations being had on a line of railway, or railroad, for mail bags and for parcels. Now, my invention consists in applying mechanical means to railways, or railroads, and the carriages which run thereon, whereby mail bags may be taken and left at any determined places, or stations, with the greatest facility, without stopping or retarding the motion or speed of the train of carriages, and by such means the number of places for taking and leaving mail bags may be increased very materially, and the general system of conveyance of mail bags facilitated. And although I have here spoken of mail bags, I mean it also to apply to bags containing parcels, for it is better to put small parcels in bags.

The principle of action of the apparatus applied is such, that a bag containing letters, or parcels, being held in such a position as to be in the way of suitable means or instruments for taking the bag, and on the other hand, where it is desirable to leave bags, there is connected with a carriage of the train, suitable apparatus or instruments to support the bag in a position to be intercepted by apparatus or instruments for taking the bag so placed. Now it will be evident that the apparatus in both cases may be varied as to its particular action or formation, to produce the desired effect, and yet remain in substance the same. I do not, therefore, confine my invention to the instruments here shown, though I believe they are the most simple which can be employed, and the best for the purpose. In my arrangement, a bar is applied at the back of a railway carriage; this bar is capable of sliding to and from the carriage in staples, affixed to the back of the carriage, usually that carriage of a train of railway or railroad carriages called the mail, when the same is intended for mail bags; but it will be evident that the apparatus may be applied to other of the carriages, when intended for the delivery of parcels, and the apparatus for parcels may be separate from the apparatus for mails. A set screw, applied by the guard, [when he has slided the bar to its position] fixes the bar for the time, till it has taken up or left the bags held thereby. A prong projects from the bar, at right angles thereto, and is curved upwards, in order, when a mail bag has been taken by it, that the same may not fly off by any motion or swing, which may take place by the same being put suddenly into motion with the train of carriages. At each station, or place where it is desired to take or leave mail bags, there is to be an apparatus suitable for holding the bags, to be

taken by the train of carriages when passing; and if bags are to be left at the same place, then there is to be fitted up suitable apparatus for receiving the bags which are carried by the bar, on the projecting prongs. The apparatus applied to the railway, or railroads, at the determined stations, or places, is similar to that applied to the railway or railroad carriage, and the apparatus is sustained by a post, or upright, on which may be placed a lamp.

Having thus explained the nature of the apparatus which I prefer for carrying out my invention, and which I have found fully to answer for taking and leaving mail bags and parcels when travelling at high speeds, I will describe the manner of using the same. The guard places the cord, strap, or chain, on to the prongs of the bar, or a number of bags may be strung on to a strap, cord, or chain, or other convenient means or instrument, and together securely placed on the prongs; he then slides out the bar, and fastens it by the screw; it will consequently follow, that when the train of carriages passes the station or place where there is a suitable apparatus the bag or bags, on the bar will be taken by a prong, or other suitable instrument; and if it be desired that there should be a bag, or bags, taken by the train, as well as left at a station, then such bag, or bags, are to be supported by suitable means, such as the prongs, the post, and the prong of the bar, will take such bag, or bags; and it only remains for me to remark, that I lay no claim to any of the parts separately, nor to their use, for any other purpose than for carrying out my invention, which I declare to consist of the application of mechanical means, such as herein explained, to railways, or railroads, and carriages traveling thereon, for taking and leaving mail bags, and parcels, whereby much time will be saved, and certainty of action obtained, and whereby the conveyance of mail bags, and parcels, will be materially facilitated, as above described.—*Rep. Pat. Inv.*

PROCEEDINGS OF SCIENTIFIC SOCIETIES—INSTITUTION OF CIVIL ENGINEERS—REPORT OF PAPERS READ AND PROCEEDINGS, SESSION 1838.

THAMES TUNNEL.

Mr. Brunel stated that they were at present* more inconvenienced by fire than by water. Some of the gases which issue forth, ignite very rapidly; and the reports from Guy's Hospital stated some of the men to be so injured by breathing these gases, that small hopes were entertained of their recovery. The explosions are frequent, and put out the candles of the workmen; but the largeness of the space prevents their being dangerous. The thickness of made ground above them is about 18 feet. He conceives that these deleterious gases issue from the mud of the river; they proceed from a corner at the top. They had used chloride of lime; but without any great success; there appeared no remedy for the inconvenience. The breathing the gas produces sickness.

EXPLOSION OF STEAM BOILERS.—A communication was read from Mr. Timperley, of Hull, on the explosion of the boiler of the Union steam-packet at that place last summer. This was attributed to the water in the boiler having become so far reduced as to lay bare the tops of the flues, which would probably be heated to a very high temperature. Water coming in contact with them in this state, on a slight lateral motion of the vessel, steam of sufficient intensity to produce the effects described might be produced.

Mr. Macneill stated that the boiler plates had in the above instance

*May 16.

been rent across like a sheet of paper. There was not a single rivet broken.

A long discussion took place on the causes to which these extraordinary cases could be referred: the violence of the explosion on bursting, appearing greater than could be referred simply to the pressure of the steam. If the water were supposed to be decomposed by contact with the hot plates, some of the oxygen would be absorbed by the metal, and the proportion requisite for an explosive mixture destroyed. But there were great difficulties in conceiving the decomposition of water by the plates of a boiler. The commission of the Franklin Institute concluded this to be impossible.*

It appeared then, that there were grounds for doubting the fact of the presence of oxygen, such as would cause an explosion. And it seemed almost unnecessary to resort to any such explanation, as the sudden generation of steam of high elasticity would produce a pressure sufficient to blow out or rend the boiler in the weakest part, before the pressure could be transmitted through the steam to the safety valve. The transmission of pressure through an elastic fluid requires time, but the action on the solid is instantaneous.

It was suggested whether a large portion of hot surface might not become suddenly exposed by the cracking off of the incrustation on the sides of the boiler. The metal expands more rapidly than the incrustation; portions of the latter may crack off and expose a large extent of hot surface to the steam and water; a sudden increase in the elastic force of the steam would necessarily ensue. The incrustation is itself a bad conductor of heat.

Mr. Field, in reply to a question respecting the rapid decay of the bottoms of copper boilers, stated, that copper is very rapidly injured by repeated heatings, and will not long bear high degrees of temperature.

Mr. Cubitt stated that he had not known of any case of explosion of a boiler containing plenty of water. With respect to a recent accident in America, which had taken place soon after the boat had started, he thought that a boiler was more likely to be short of water at starting than at any other time, for the steam will probably have been blowing off for some time, and the men have neglected to supply the boiler; whereas after the vessel has started, the pumps worked by the engine supply the boiler. He should think that a boiler is more likely to be short of water before or just after starting, than at any other time.

Mr. Field stated that the vessel had stopped, and the explosion took place while taking up a passenger; the safety valve had been held down. In all these cases of explosion the difficulty which he experienced was, how to account for the pressure being suddenly increased by the amount which must be supposed. It did not appear to him sufficient to suppose that water flowed over hot flues. If the whole of the top of the fire-place were red hot, this could not produce the effect. The steam boilers in America are generally of a form ill adapted to resist pressure.

Mr. Buddle stated that the only clearly ascertained fact seemed to be, that these explosions took place when the boilers are dry. He had a case of twin boilers, standing side by side; the dry one exploded; no cause could possibly be assigned but that it was dry. The steam communication betwixt the boilers was free, by a pipe *eight* inches diameter. It was not a collapse, but the boiler was torn into a thousand pieces. There are two

* See Report of Franklin Institute on the Explosion of Steam Boilers.

distinct cases; the one a rent or bursting, the other an explosion, in which the parts are thrown to a considerable distance.

Mr. Cubitt called attention to the remarkable case mentioned by Mr. Buddle, of two boilers connected together by a steam pipe of eight inches diameter, the communication free betwixt them, but one short of water; the other having its proper quantity of water. The dry boiler blew up with a great explosion, the other remaining uninjured. The steam was blowing off at the time. With respect to the nature of the report, Mr. Buddle stated that he had not himself heard it, but it was represented as sudden and short; any representation of this nature cannot be depended on, as two persons situated in different positions will give very different accounts. This had occurred to his knowledge on the explosion of a coal mine. He was close by, and thrown down; the report was smart like that of a six-pounder; at two miles off, it was like a peel of thunder, shaking the houses and throwing down the furniture. One peculiar feature in the explosion of steam boilers is the rending and crumpling up of the boiler plates. The plates are rent and twisted as if of paper.

History and Construction of Westminster Bridge, accompanied with detailed Drawings.—By F. Whishaw, M. Inst. C. E. This account of Westminster Bridge has been extracted from the very voluminous documents in the Westminster Bridge Office, access to which was given to the author of this paper by the kindness of Mr. Swinburne, the resident engineer to the bridge.

The first act was passed in 1736, and empowered certain commissioners to raise moneys by lottery. Three sites were pitched upon; the Horse-ferry, over against the Palace Yard, and over against the Woolstaple, which latter was finally fixed on. The scheme was violently opposed by the city of London and the Thames watermen. The commissioners selected a very curious and well-designed wooden superstructure, by James King; but having determined that the bridge should be of stone, they accepted a proposal from Mr. Labelye to found one pier by means of caissons, and which he had offered to build at his own expense.

This bridge, so lasting a monument to the genius of Labelye, consists of fifteen semicircular arches, decreasing regularly in span by 4 feet from the centre, which measures 76 feet, to the sixth arch on each side, which is 52 feet in span; all the arches spring from the line of low water of 1736. The whole distance between the abutments is 1068 feet, with 870 feet clear waterway, and 198 feet solid. A peculiar feature in this bridge is, that the spandrels are formed of radiated Purbeck blocks, with occasional bond stones, and the interior filled with ballast and rubbish.

The design of Mr. Labelye was the only one for laying the foundations of the piers under water, and the application of caissons for this purpose then first took place. The construction of these caissons and method of founding the piers by means thereof are fully described and illustrated. The piles were driven by an engine invented by Mr. Valoue, a watchmaker; it was erected on a platform, fixed on the top of a barge, and worked by three horses walking round and turning an upright shaft, on which was fixed a large cog-wheel and a drum, on which the rope was wound, and passing by pulleys to the top of the guide frames was connected with a follower furnished with tongs, as in the common pile engine. The number of strokes in an hour was about 150, at an elevation of 9 feet; the weight of the ram 1700lbs. The piles were generally cut off; the time occupied in cutting off a pile about 15 inches square and 10 feet under water being not more than a minute and a half. The construction of the abutments

and of the arches is fully described, and the quantity of stone employed in the middle 76 feet arch, and the two adjoining 72 feet, is stated; the expense of these three arches was 24,074*l.*

The centres employed were on the principle of the diagonal truss; for the five middle arches three rows of piles were driven on each side to support the centres, and for the other arches only two rows. Each centre consisted of five ribs of fir timber, resting on transverse and longitudinal oaken plates. The five centres used on the Westminster side were afterwards used for the corresponding arches on the Surrey side; the striking of the centres was first performed by means of circular wedges of a peculiar construction; this mode, however, from its expense, was superseded by straight wedges.

A most interesting portion of the history, is that which relates to the 15 feet sunken pier. There was no piling under the caisson bottoms, and the removal of gravel of the bed of the river very near the pier in question occasioned consequently a sinking. The progress and nature of the sinking are accurately detailed. The south point had settled 14 inches and the north point 13 inches; and the sinking still going on, it was determined to remove the superstructure above the sunken pier and damaged arches; the sinking still continued, but at last appeared to stop, and the whole amount was found to be 3 feet 4 inches at the north-west angle, and 2 feet 7 inches at the south-east angle, of the pier. Centres were erected under the two damaged arches, the adoption of which plan was recommended to the commissioners in the following words:—"If the pier should settle much more, it is not in the power of any mortal agent or agents to hinder the arches from following it, as long as it is possible; and therefore, in that case, the two arches instead of parting asunder, and their materials falling into the river, and not to be taken up without a great expense of time and money, will be received and their materials supported and secured, in order to their being regularly unbuilt." The pier, however, lightened as above described, did not continue to sink, and the weight over the piers was considerably reduced by introducing segment arches over the 15 feet pier, and half arches over the adjoining piers, leaving a considerable void space beneath each.

Labeyle presented to the commissioners several reports on the open joints, on the sunken pier, on the Surrey New Road, and on the completion of the works. These are most interesting, serving, as they do, to exhibit the state of engineering at that time in the country.

A detailed account is also given of the ingenious wooden superstructure designed by Mr. James King, and of Mr. Batty Langley's design for a wooden bridge at the Horse-ferry. The author has also collected, at immense pains, the prices of materials and of labor, as paid in the erection of Westminster Bridge; he has also compiled a journal of works from the commencement of the undertaking to the time the bridge was opened. These most interesting and instructive documents are collected from the voluminous records deposited in the Bridge Office.

The paper is accompanied by an atlas of eleven drawings, showing the site and all the details of the bridge, with facsimile signatures of Charles Labelye the engineer, and Messrs. Jelfe and Tufnell the contractors.

THE THAMES TUNNEL.—COPY OF MR. WALKER'S REPORT TO THE TREASURY, ON THE WORKS AT THE THAMES TUNNEL.

In consequence of several propositions made to the Lords commissioners of her Majesty's treasury, for further means for continuing and facilitating the work, they directed James Walker, President of the Institution of Civil

Engineers, to take into consideration the various papers relative to the late irruption of the river, with the special reports from Mr. Brunel, of the works proposed to be carried on at the tunnel, and to report to the treasury his views and opinions on the eligibility and means of prosecuting the work.

"I gave the subject, [says the reporter], my immediate attention, and was preparing a report thereon, when on the 2nd November, another [the fourth] irruption of the Thames took place, and on the 6th, when I visited the works of the tunnel, Mr. Brunel, the engineer, and Mr. Charlier, the secretary, requested a postponement of my report for a short time, until they should complete an expected arrangement with the navigation committee of the river Thames from which they expected increased facility and security. This request I communicated to Mr. Baring, by letter, on the 9th November.

I have since received Mr. Spearman's letter of the 2nd December, transmitting to me, by command of the lords of the treasury, a copy of a letter from the secretary to the Thames Tunnel Company, dated 15th November, together with a report of Mr. Brunel on the present state of the tunnel, and the best mode of proceeding, and also a plan of the works, with a request that I would communicate to their lordships my opinion upon the several points referred to in the papers, previous to their determining on the proposals and recommendations of the company.

Since receiving the above instructions, Mr. Spearman has stated to me the desire to be, that every point, particularly as respects cost or estimate, which I consider of importance in the general question of the tunnel, should be included in my report, so as to bring the whole fairly under the consideration of their lordships.

That Mr. Brunel's different reports in which the same recommendations are repeated, may be brought to their lordships' recollection, I shall give a short abstract of the main points in the order of date.

In his report of 2nd May 1837, Mr. Brunel ascribes the difficulties which had retarded the progress of the tunnel for the last five months to the excessive rains of the preceeding autumn, liquifying the ground between the ceiling of the shield and the river, and causing it to run into the works; he states that this has been augmented by his being deprived of the pumping well and drain from Wapping, which is stated to have been originally intended, and to have been considered the most efficient means of drainage, particularly as the dip of the strata is to that side, and that before any satisfactory progress can be calculated on, the proposed pumping well, with a drain or drift-way, should be made, but that a preferable plan would be to sink the fifty-feet shaft for the foot passengers' descent, which would, he considers, be a better means of drainage, and would give employment to the workmen when not in the shield. The fact of the pumping at the entrance of the London Docks having dried the wells in that neighborhood, is adduced as a proof that a pumping-engine on the Middlesex side would diminish the land-springs in the tunnel.

(To be continued.)

The Philadelphia Gazette of the 7th says:—"The receipts of the Philadelphia, Wilmington and Baltimore Railroad Company, for the last quarter, including the months of June, July and August, amounted to upwards of $127,000, and those of the Newcastle line to Baltimore, to upwards of $58,000, making the receipts of the two companies more than $185,000.

This has not been a travelling season certainly, and we may therefore confidently calculate on an increased income in the corresponding quarter of next year.—*United States Gazette.*